

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
27 May 2004 (27.05.2004)

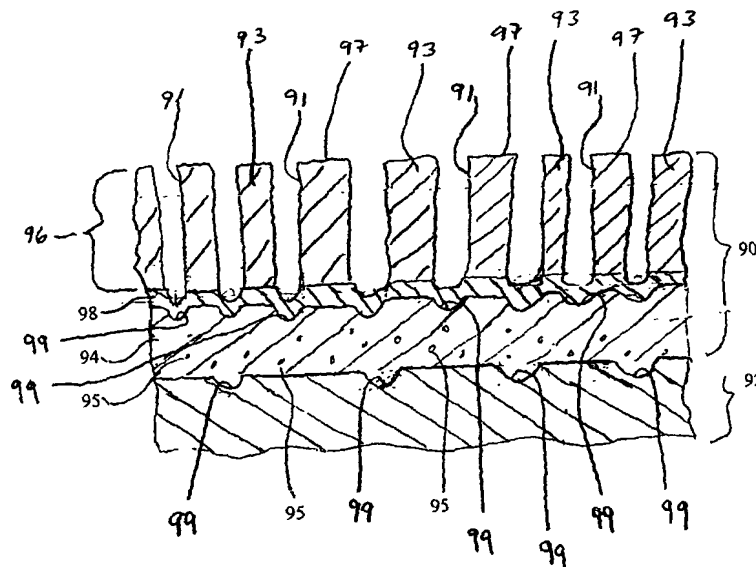
PCT

(10) International Publication Number
WO 2004/043691 A1

- (51) International Patent Classification⁷: **B32B 15/04**, F03B 3/12, B29B 9/00, C23C 8/00, 16/00
- (21) International Application Number: PCT/US2003/036035
- (22) International Filing Date: 12 November 2003 (12.11.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/425,524 12 November 2002 (12.11.2002) US
- (71) Applicant (for all designated States except US): **UNIVERSITY OF VIRGINIA PATENT FOUNDATION** [US/US]; 1224 West Main Street, Suite 1-110, Charlottesville, VA 22903 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **WORTMAN, David, J.** [US/US]; 5614 Liberty Woods Court, Hamilton, OH 45011 (US). **WADLEY, Haydn, N., G.** [US/US]; 4922 Barnfield Drive, Keswick, VA 22947 (US).
- (74) Agent: **DECKER, Robert, J.**; University of Virginia Patent Foundation, 1224 West Main Street, Suite 1-110, Charlottesville, VA 22903 (US).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:
— with international search report

[Continued on next page]

(54) Title: EXTREMELY STRAIN TOLERANT THERMAL PROTECTION COATING AND RELATED METHOD AND APPARATUS THEREOF



(57) Abstract: Method and Apparatus for efficiently applying coating systems to a surface that can survive the thermal gradient that is encountered in high temperature, high heat flux environments such as a rocket engine or like using vapor or cluster deposition process such as a directed vapor deposition (DVD) approach. Method and Apparatus provides electron or other energetic beam technique to evaporate and deposit compositionally and morphologically controlled bond coats at high rate while providing a highly strain tolerant thermal barrier coating that has an improved porosity morphology between columnar grains.